1.3

Drawing atoms

Name _____ Class _____ Mark _____ / 27

What you are practising

I can find the protons, neutrons and electrons from an atom's symbol and draw its electrons in shells.

Worked example $^{14}_{7}N$

protons 7
neutrons 7
electrons 7
arrangement 2, 5

Five in the 2nd shell is more than half of eight: one pair, three singles.

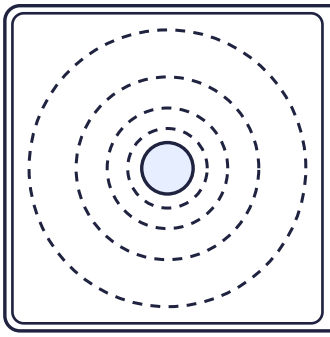
The six rules

1. Protons and neutrons sit in the nucleus; electrons orbit it in shells.
2. Electrons = protons = atomic number (bottom number).
3. The 1st shell holds up to 2 electrons; the 2nd and 3rd up to 8 each.
4. Neutrons = mass number (top) − atomic number (bottom).
5. Fill from the 1st shell outwards. Start a new shell only when the one inside it is full.
6. Place electrons at N, E, S and W first. When a shell is more than half full, they pair up. The 1st shell's two sit as a pair at the top.

Drawing atoms: ten to work out

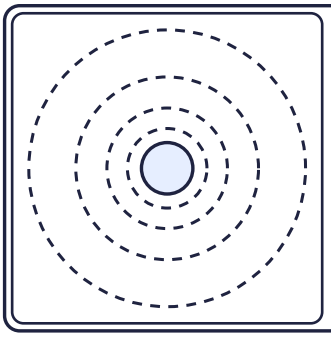
2 marks each [20]

Write the protons, neutrons and electrons. Draw the electrons as crosses on the guide rings (use only the shells you need), then write the arrangement, e.g. 2, 8, 1. Watch rule 6.



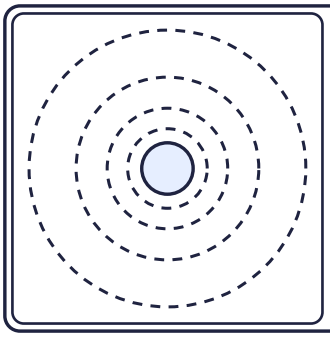
1 Helium $^{4}_{2}He$

protons _____
neutrons _____
electrons _____
arrangement _____



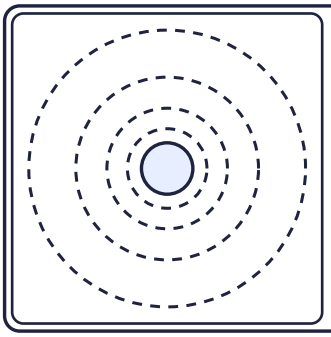
2 Lithium $^{7}_{3}Li$

protons _____
neutrons _____
electrons _____
arrangement _____



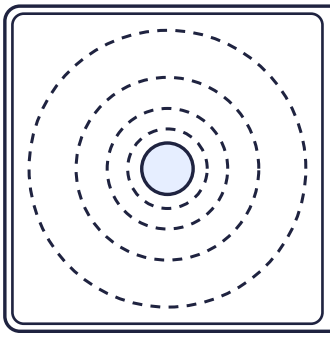
3 Carbon $^{12}_{6}C$

protons _____
neutrons _____
electrons _____
arrangement _____



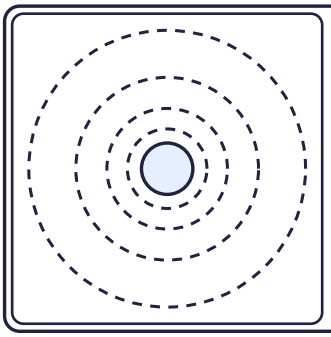
4 Oxygen $^{16}_{8}O$

protons _____
neutrons _____
electrons _____
arrangement _____



5 Neon $^{20}_{10}Ne$

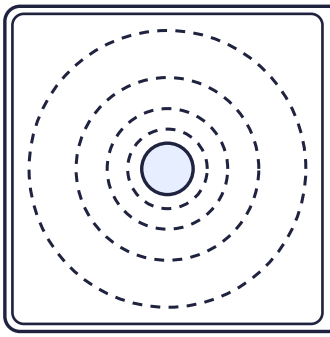
protons _____
neutrons _____
electrons _____
arrangement _____



6 Sodium $^{23}_{11}Na$

protons _____
neutrons _____
electrons _____
arrangement _____

Page done? Tick it off ◌



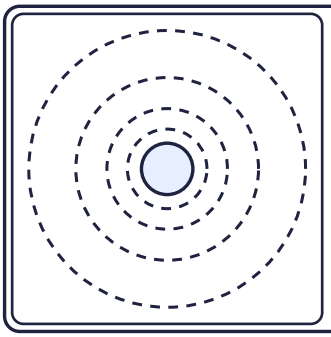
7 **Aluminium** $^{27}_{13}Al$

protons _____

neutrons _____

electrons _____

arrangement _____



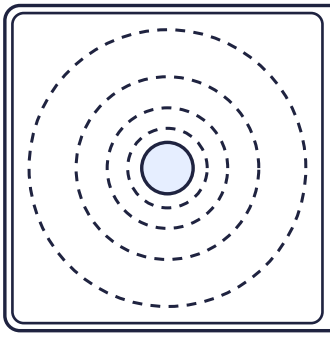
8 **Sulphur** $^{32}_{16}S$

protons _____

neutrons _____

electrons _____

arrangement _____



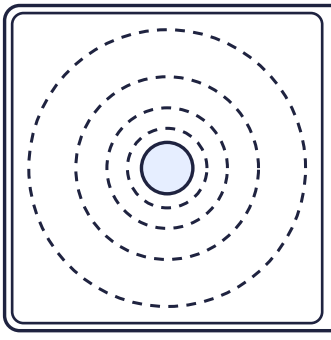
9 **Argon** $^{40}_{18}Ar$

protons _____

neutrons _____

electrons _____

arrangement _____



10 **Potassium** $^{39}_{19}K$

protons _____

neutrons _____

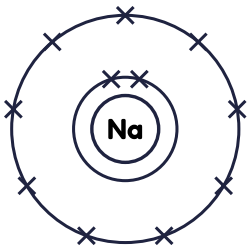
electrons _____

arrangement _____

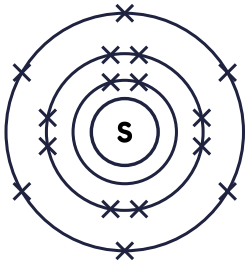
Check the rules [4]

Each drawing below breaks at least one of the six rules. Write down which rule or rules, and what it should look like instead.

A a student's atom of sodium **[2]**



B a student's atom of sulphur **[2]**



Looking across your ten [3]

1 Which of your ten atoms have a full outer shell? Which group are they in? **[1]**

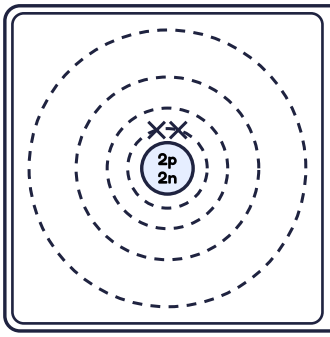
2 Which have exactly one electron in the outer shell? Which group are they in? **[1]**

3 Sodium and potassium sit in the same group. Give one thing their drawings have in common. **[1]**

Answers

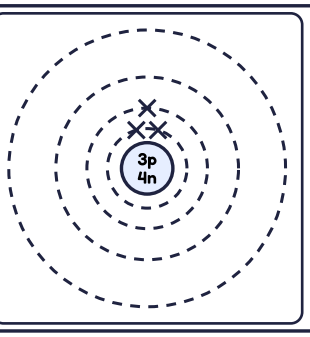
Drawing atoms [20]

1 mark for protons, neutrons and electrons all correct. 1 mark for the drawing and arrangement: right number of crosses in each shell, singles at N, E, S, W before any pair.



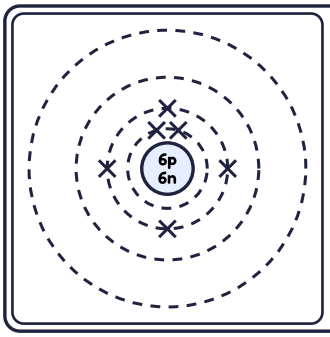
1 Helium $^{4}_{2}He$

protons	2
neutrons	2
electrons	2
arrangement	2



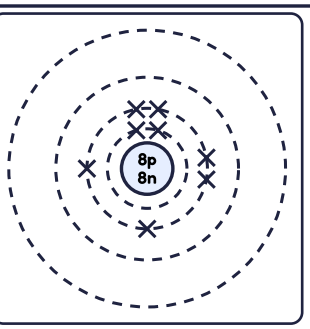
2 Lithium $^{7}_{3}Li$

protons	3
neutrons	4
electrons	3
arrangement	2, 1



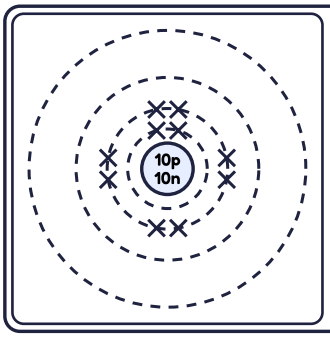
3 Carbon $^{12}_{6}C$

protons	6
neutrons	6
electrons	6
arrangement	2, 4



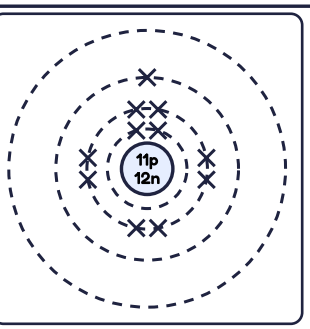
4 Oxygen $^{16}_{8}O$

protons	8
neutrons	8
electrons	8
arrangement	2, 6



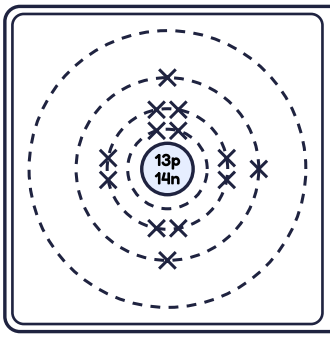
5 Neon $^{20}_{10}Ne$

protons	10
neutrons	10
electrons	10
arrangement	2, 8



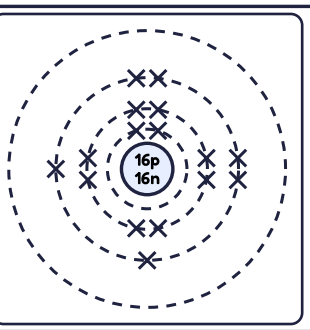
6 Sodium $^{23}_{11}Na$

protons	11
neutrons	12
electrons	11
arrangement	2, 8, 1



7 Aluminium $^{27}_{13}Al$

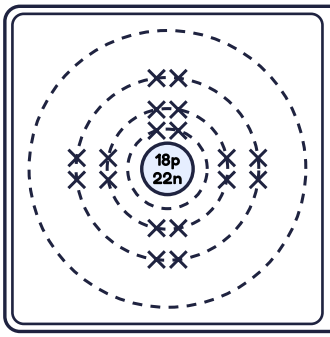
protons	13
neutrons	14
electrons	13
arrangement	2, 8, 3



8 Sulphur $^{32}_{16}S$

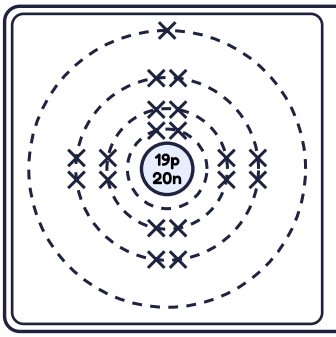
protons	16
neutrons	16
electrons	16
arrangement	2, 8, 6

Page done? Tick it off



9 **Argon** $^{40}_{18}Ar$

protons	18
neutrons	22
electrons	18
arrangement	2, 8, 8



10 **Potassium** $^{39}_{19}K$

protons	19
neutrons	20
electrons	19
arrangement	2, 8, 8, 1

Check the rules [4]

A Breaks rules 3 and 5 **(1)**. Nine electrons have been put in the 2nd shell, which holds a maximum of eight. Sodium has 11 electrons, so the eleventh starts a 3rd shell: 2, 8, 1 **(1)**.

B Breaks rule 6 **(1)**. The 3rd shell holds six electrons. Six out of a possible eight is more than half full, so they pair up: two pairs and two singles, not six evenly spread **(1)**. The arrangement 2, 8, 6 is correct; only the drawing is wrong.

Looking across your ten [3]

1 Helium, neon and argon. Group 8 (0), the noble gases (group 18). Helium's full shell holds two, not eight **(1)**.
2 Lithium, sodium and potassium. Group 1, the alkali metals **(1)**.
3 Both have one electron in the outer shell **(1)**. Potassium has one more occupied shell, so its outer electron sits further from the nucleus.

Common slips

Carbon has four electrons in the 2nd shell: exactly half, not more than half, so all four stay single. Oxygen (six) is the contrast: two pairs and two singles.
Neutrons are mass number minus atomic number: top minus bottom. Do not read the top number as the protons.
Potassium needs a 4th shell. Nine electrons in the 3rd shell (2, 8, 9) breaks rule 3.
Helium has a full outer shell: the 1st shell holds only two.

How to revise this

Look at the six rules. Cover them. Write them out from memory. Check against page 1. Then redraw only the atoms you got wrong, without looking at the answers.